



Course Syllabus for
DAUSY National Ph.D. Program in Autonomous Systems
(year 2022-23)

Course title	Modeling and simulation of biological and medical systems
Scientific Discipline Sector	ING-INF/04
Hours of instruction	30 hours
CFU	3 CFU
Semester, period	January-June 2023
Goal	This course provides mathematical tools to model, analyze, simulate and control biological and medical systems, exploiting both deterministic and stochastic frameworks.
Syllabus	<ul style="list-style-type: none"> - Review of basic concepts of biology and probability; deterministic vs. stochastic approach. - Stochastic approach: Reaction Networks, Continuous-Time Markov Chains; the Master Equation and its properties, stationary distribution, the macroscopic equation, one-step processes. - Mesoscopic models: the Langevin Equation and the Wiener Process. - Deterministic approach: ordinary differential equation (ODE) models. - Modeling, quantitative and qualitative analysis, simulation and control examples. - Numerical simulation of deterministic and stochastic systems. - Biological and biomedical applications.
Bibliography	<ul style="list-style-type: none"> - J. D. Murray, Mathematical biology, 3rd edition. Springer New York, 2001. - J. Keener, J. Sneyd (Eds.), Mathematical physiology. Springer New York, 2009. - E. Klipp, W. Liebermeister, C. Wierling, and A. Kowald, Systems biology: a textbook, John Wiley & Sons, 2016. - Slides and support material from lecturer.
Examination method	Final examination by written/oral questions.